High-temperature Mechanical Properties of a DOP-26 Iridium Alloy under Impact Loading

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Abstract. Iridium alloys have been utilized as structural materials for certain high-temperature applications due to their superior strength and ductility at elevated temperatures. In some applications, the iridium alloys may be subjected to extreme environments that include a combination of high temperature and high-speed impact. Thus, the high-temperature high-strain-rate mechanical properties of the iridium alloys must be fully characterized to understand the mechanical response of the components in these severe applications. Kolsky bars (also called split Hopkinson bars) have been employed for high-strain-rate characterization of materials in compression or tension at room temperature. It has been challenging to directly apply the Kolsky bars for dynamic measurements at high temperatures even in compression, let alone in tension, which is significantly more difficult. In this study, we modified the conventional room-temperature Kolsky compression and tension bars for dynamic high-temperature compressive and tensile characterization of iridium alloys. DOP-26 iridium alloy blanks with a thickness of 0.65 mm were made into disc specimens with a diameter of 3 mm for compression tests and dog-bone-shape sheet specimens with a gage section of 2.54 mm (width) by 6.35 mm (length) for tensile tests. The stress-strain curves of the DOP-26 iridium alloy were obtained in compression at four different strain rates (~300, 1000, 3000, and 10000 s\textsuperscript{-1}), in tension at two different strain rates (~1000 and 3000 s\textsuperscript{-1}), and in both cases at two different temperatures (750 and 1030°C). Both compressive and tensile stress-strain curves of the DOP-26 iridium alloy showed significant strain-rate and temperature effects. At certain strains, the flow stresses significantly increase with increasing strain rates but decrease when temperature increases. The dynamic tensile stress-strain curves also demonstrated high ductility of the DOP-26 iridium alloy at high strain rates and elevated temperatures. The dynamic tensile stress-strain curves were also compared with the compressive stress-strain curves at similar strain-rate and temperature conditions. Uncertainties in the dynamic high-temperature compression and tensile tests are discussed.

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